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[Title of Invention]	DEVICE CONNECTION METHOD AND STRUCTURE THEREOF
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[NAME OF THE DOCUMENT] SPECIFICATION

[TITLE OF THE INVENTION] DEVICE CONNECTION METHOD AND STRUCTURE
THEREOF

[CLAIMS FOR A PATENT]

[Claim 1] A connection method of a device connected with a device receiving body involving a mutual electrical connection, characterized in that the connection method comprises the steps of:

- providing a fitting opening for the device receiving body;
- providing a terminal for a periphery of an fitting portion of the device;

- arranging a substrate on which a conductor is printed on the periphery of the fitting opening;

- providing another terminal by extending the printed portion of the conductor on an inner part of the fitting opening;

- arranging the another terminal to be folded in an inner periphery of the fitting opening; and

- making the terminal and the another terminal come into contact when the device is fitted into the fitting opening.

[Claim 2] A connection method set forth in claim 1, characterized in that the connection method further comprises a step of:

- providing positioning means for determining a relative rotational position between the device and the device receiving body.

[Claim 3] A connection method set forth in claim 1 or 2, characterized in that the connection method further comprises a step of:

arranging annular seal members surrounding the fitting opening between the device and the substrate and between the substrate and the device receiving body.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Field of the invention]

The present invention relates to a connection method of a device connected with a device receiving body involving a mutual electrical connection.

[0002]

[PRIOR ART]

In the case where connected devices involving an electrical connection are connected, in general, they are electrically connected via a harness after fixing a device to the other device. For example, Fig. 4 shows a case where an ignition coil 1 is employed as a device and the ignition coil 1 is attached to an engine main body of an automobile (not shown). An igniter portion 2 of the ignition coil 1 is connected with a distributor (not shown) via an ignition cable as a harness, and further the distributor is connected with an ignition plug.

[0003]

Conventionally, the ignition cable is connected with the ignition coil 1 via a male connector 3 shown in Fig. 5 and a female connector 4 shown in Fig. 6. The male connector 3 is integrally formed with a head portion of the ignition coil 1 in a protruding manner and a construction is formed, in which a pin-like terminal 5 is protruded inside of an insertion hole

3a opened in a tubular manner.

[0004]

In contrast, the female connector 4 is provided with an insertion portion 4b, which is fitted to an inner periphery of the insertion hole 3a, in a housing 4a thereof, which is fitted to an outer periphery of the insertion hole 3a, and have a structure in which a press-fit terminal 6 as another terminal is housed in the insertion hole 4b. Further, an ignition cable 7 extending from the distributor is connected with the press-fit terminal 6.

[0005]

After attaching the ignition coil 1 to the engine main body, by inserting the female connector 4 into the male connector 3, the terminal 5 is inserted into the press-fit terminal 6 so as to be mutually shorted. In that time, a liquid-tight function inside the insertion hole 3a is ensured by means of a packing 8 provided in the outer periphery of the insertion portion 4b and an engagement protrusion 3b provided at a distal end portion of the insertion hole 3a is engaged with a recess portion 4c of the housing 4a so that a displacement prevention is ensured.

[0006]

[Problems to be solved by the invention]

In the device connection method described above, work of a connection of the ignition cable 7 via the male connector 3 and the female connector 4 is necessary after attaching the ignition coil 1 to the engine main body. Thus, the connectors 3, 4 intervene the connection of the ignition cable 7 so that

process of connection between the connectors 3, 4 is necessary. The process causes increasing in an electrical connection cost of the ignition coil 1 added into the engine main body.

[0007]

Especially, not only the connectors 3, 4 need the electrical connection, but also a production cost of the connectors 3, 4 itself is increased in a case where a liquidtight function and a displacement prevention function is added so that a structure thereof comes to be complicated. That situation leads to a problem that the electrical connection cost is further increased.

[0008]

The present invention was made considering the above-described problems, and it is an object of the present invention to provide a device connection method by which an electrical connection can be ensured only by connecting devices so that the connectors are omitted, thereby the electrical connection cost can be suppressed.

[0009]

[MEANS FOR SOLVING THE PROBLEMS]

The present invention set forth in claim 1 is summarized that a connection method of a device connected with a device receiving body involving a mutual electrical connection includes the steps of providing a fitting opening for the device receiving body, providing a terminal for a periphery of an fitting portion of the device, arranging a substrate on which a conductor is printed on the periphery of the fitting opening, providing

another terminal by extending the printed portion of the conductor on an inner part of the fitting opening, arranging the another terminal to be folded in an inner periphery of the fitting opening and making the terminal and the another terminal come into contact when the device is fitted into the fitting opening.

[0010]

In this connection method, when the device receiving body is fixedly fitted into the device, the terminal of the outer periphery of the fitting portion thereof is shorted with the another terminal of the inner periphery of fitting opening. A conductor printed portion of the substrate disposed at the periphery of the fitting opening of the device receiving body is extended and arranged in the inner periphery of the fitting opening in a folded manner so as to form the another terminal. The terminal is electrically connected with the conductor printed portion of the substrate. Thereby, the substrate functions as a harness so that the device is electrically connected with the device receiving body. Accordingly, fitting the second device into the first device, an electrical connection becomes possible, and the electrical connection cost comes to be decreased. Further, since the folded part to be the another terminal in the substrate is sandwiched between the fitting opening and the terminal to be fixed, stability of the electrical connection between the terminal and the another terminal is ensured.

[0011]

The present invention set forth in claim 2 is summarized

that the connection method of claim 1 further includes a step of providing positioning means for determining a relative rotational position between the device and the device receiving body.

[0012]

In this connection method, the relative rotational position between the device and the device receiving body is determined by the positioning means so that the terminal and the another terminal are supported in a regular short condition when the device is in a fitting condition. Thereby loose connection is prevented.

[0013]

The present invention set forth in claim 3 is summarized that the connection method of claim 1 or 2 further includes a step of arranging annular seal members surrounding the fitting opening between the device and the substrate and between the substrate and the device receiving body.

[0014]

In this connection method, the annular seal members surrounding the fitting opening are intervened between the device and the substrate and between the substrate and the device receiving body so that the seal members keep a fitted portion of the device tightly and a liquid tight function can be ensured.

[0015]

[PREFERRED EMBODIMENTS]

An embodiment of the present invention is explained in detail referring to the accompanying drawings. Figs. 1 and 2

show the embodiment of the device connection method of the present invention, where Fig. 1 is an exploded perspective view showing the device connection method of the present invention and Fig. 2 is a sectional view of a certain part of the device in a fitting condition. In the present embodiment, a case where a cylinder head 11 of an engine is employed as the first device and an ignition coil device 10 is employed as the second device are explained as examples.

[0016]

A main body portion 12 of the ignition coil device 10 is formed into a cylindrical shape, and its proximal end (shown as an upper end in the drawing) has a rectangular head portion 13. The head portion 13 side of the main body portion 12, which is a fitting portion 14 to be fitted with a cylinder head 11, has a diameter larger than that of a fixing portion 15 of the distal end (shown as a lower end in the drawing) thereof.

[0017]

An ignition coil attaching hole 17 for fixedly fitting the main body portion 12 of the ignition coil device 10 is provided in the cylinder head 11. This ignition coil attaching hole 17 passes a cylinder bore 18 through, the vicinity of the opening portion thereof is a fitting opening 19 into which the fitting portion 14 is fitted having an appropriate gap, and a support portion 20 into which the fixing portion 15 is closely fitted is formed in the inside facing the cylinder bore 18.

[0018]

The ignition coil device 10 is provided with a terminal

21 on the outer periphery of the fitting portion 14 for the fitting opening 19, the cylinder head 11 is provided with a circuit substrate 23 on which a conductor 22 is printed on the periphery of the fitting opening 19, and the conductor 22 is extended on the inner periphery to be a another terminal 24. This another terminal 24 is folded on the inner periphery of the fitting opening 19 to be arranged there and is connected electrically to the terminal 21 when the ignition coil device 10 is fitted into the fitting opening 19. In the present embodiment, a flexible FPC (Flexible Printed Circuit) is employed as the substrate 23.

[0019]

The terminal 21 is folded in two to be formed into a plate spring shape to which resiliency toward the outside is imparted so that an arc-like portion protruding outward becomes a contact. Four of the terminals 21 are provided, and the respective terminals 21 are accommodated in attaching recesses 25 provided at equal intervals in the peripheral direction of the fitting portion 14 so that the contact portions thereof protrude. On the other hand, corresponding to the terminals 21, four of the another terminals 24 are provided at equal intervals on the inner periphery of the fitting opening 19. That is, four of the conductors 22 printed on the substrate 23 are provided corresponding to the respective another terminals 24. In the present embodiment, although the numbers of the terminals 21 and 24 are set to four, the present invention is not limited to this, and the number can be a necessary arbitrary one.

[0020]

A positioning hole 26 parallel to the fitting direction of the ignition coil device 10 is provided in the periphery of the ignition coil attaching hole 17 of the cylinder head 11. A positioning pin 27 is provided on the lower face of a corner of the head portion 13 of the ignition coil device 10, and positioning means is composed of this pin 27 and the positioning hole 26. That is, the relative position between the another terminal 24 and the terminal 21 is determined by fitting of the positioning hole 26 and the positioning pin 27.

[0021]

Respective attaching holes 28 are provided in a pair of corners except for a corner having the positioning pin 27 and the opposite corner thereof in the head portion 13 of the ignition coil device 10. Bolts 29 inserted into the attaching holes 28 is threaded into the substrate 23 to be screwed onto the cylinder head 11, whereby tightening and fixing of the ignition coil device 10 is executed. At this time, collars 30 for receiving the tightening force of the bolts 29 are threaded into the attaching holes 28. Accordingly, when the head portion 13 is tightened and fixed as described above, the substrate 23 comes to be fixed between the head portion 13 and the cylinder head 11 by pressure.

[0022]

O-rings 31 and 32 are inserted between the substrate 23 and the head portion 13 and between the substrate 23 and the cylinder head 11, each centering on the ignition coil attaching hole 17, and the head portion 13 is supposed to press-contact with these. When the head portion 13 is tightened, the respective

O-rings 31 and 32 are fixed to the substrate 23 by pressure to seal up the space between the head portion 13 and the cylinder head 11. In the present embodiment, since an O-ring 33 is inserted between the fixing portion 15 of the ignition coil device 10 and the support portion 20 of the ignition coil attaching hole 17, airtightness in the cylinder bore 18 can be ensured, in combination with the O-rings 31 and 32.

[0023]

Accordingly, in the device connection method of the present embodiment, the ignition coil device 10 is stuck into the ignition coil attaching hole 17 while the positioning pin 27 is inserted into the positioning hole 26, so that the fitting portion 14 on which the terminals 21 are arranged is positioned inside the fitting opening 19 on which the another terminals 24 are arranged. Then, the terminals 21 and the terminals 24 are connected electrically, and the ignition coil device 10 and the conductor 22 of the substrate 23 with which the cylinder head 11 is provided are electrically connected. In the present embodiment, since an electrical connection can be ensured at the same time as the ignition coil device 10 is fitted into the fitting hole 19 of the cylinder head 11, connection work employing a conventional complex, expensive connector by a harness becomes unnecessary.

[0024]

Moreover, since the folded portion of the substrate 23 to be the another terminal 24 is sandwiched between the inner periphery of the fitting opening 19 and the terminal 21 of the outer periphery of the fitting portion 14 to be fixed, stability

of the contact between these another terminal 24 and terminal 21 can be ensured.

[0025]

Further, since the positioning hole 26 and the positioning pin 27 are provided between the ignition coil device 10 and the cylinder head 11 when the ignition coil device 10 is fixedly fitted into the ignition coil attaching hole 17, the position in the rotation direction of the cylinder head 11 and the ignition coil device 10 can be decided simply and correctly by the insert position of the positioning hole 26 and the positioning pin 27. Thus, in the state where the ignition coil device 10 is fitted, a normal electrical contact state between the another terminal 21 and the terminal 24 can be maintained constantly, and it can be prevented that these parts are in imperfect contact.

[0026]

Since the O-rings 31 and 32 are inserted between the substrate 23 and the head portion 13 of the ignition coil device 10 and between the substrate 23 and the cylinder head 11, the fitting portion of the ignition coil device 10 can be sealed up by the O-rings 31 and 32, whereby waterproof function can be ensured. In the present embodiment, not only can the waterproof function be demonstrated as described above, the airtightness of the ignition coil attaching hole 17 can be ensured by the O-ring 33 which is inserted between the fixing portion 15 of the ignition coil device 10 and the support portion 20 of the ignition attaching hole 17, whereby it can be prevented that combustion pressure inside the cylinder bore 18 escapes.

[0027]

Fig. 3 shows another embodiment, where different points are mainly summarized that tightness between the head portion 13 of the ignition coil device 10 and the cylinder head 11 is achieved by means of a rubber packing 50 as a seal member outsert-formed onto the substrate 23.

[0028]

More specifically, Fig. 3 is an enlarged sectional view of a certain part of a tightly fitted portion, the head portion 13 of the ignition coil device 10 and the cylinder head 11 are provided with annular grooves 51 and 52 opposed to each other, respectively. On the other hand, an opening 53 is formed in a proper gap so as to be positioned inside the annular grooves 51, 52 and the rubber packing 50 is outsert-formed on both sides of the substrate 23 so as to fill up the opening 53.

[0029]

Accordingly, according to the present embodiment, the rubber packing 50 is formed so as to project from both sides of the substrate 23. When the rubber packing 50 is positioned in the annular grooves 51, 52 and the head portion 13 is tightened by means of the bolt 29, close adherence between the rubber packing 50 and the head portion 13 and between the rubber packing 50 and the cylinder head 11 can be achieved. Thereby similar functions as the aforementioned embodiment can be achieved.

[0030]

In the above two embodiments, although an example is employed where the cylinder head 11 is employed as the first

device and the ignition coil device 10 is employed as the second device, of course, the present invention is not limited to this example and can be applied to various cases of the connection between a first device and a second device which mutually need an electrical connection.

[0031]

[EFFECTS OF THE INVENTION]

According to the present invention set forth in claim 1, when the device receiving body is fixedly fitted into the device, the terminal of the outer periphery of the fitting portion thereof is shorted with the another terminal of the inner periphery of fitting opening. A conductor printed portion of the substrate disposed at the periphery of the fitting opening of the device receiving body is extended and arranged in the inner periphery of the fitting opening in a folded manner so as to form the another terminal. The terminal is electrically connected with the conductor printed portion of the substrate. Thereby, the substrate functions as a harness so that the device is electrically connected with the device receiving body. Accordingly, fitting the second device into the first device, an electrical connection becomes possible, and the electrical connection cost comes to be decreased. Further, since the folded part to be the another terminal in the substrate is sandwiched between the fitting opening and the terminal to be fixed, stability of the electrical connection between the terminal and the another terminal is ensured.

[0032]

According to the present invention set forth in claim 2, in the connection method of claim 1, the relative rotational position between the device and the device receiving body is determined by the positioning means so that the terminal and the another terminal are supported in a regular short condition when the device is in a fitting condition. Thereby loose connection is prevented.

[0033]

According to the present invention set forth in claim 3, in the connection method of claim 1 or 2, the annular seal members surrounding the fitting opening are intervened between the device and the substrate and between the substrate and the device receiving body so that the seal members keep a fitted portion of the device tightly and a liquid tight function can be ensured.

[BRIEF DESCRIPTION OF DRAWINGS]

[FIG. 1]

An exploded perspective view showing a device connection method according to a first embodiment of the present invention.

[FIG. 2]

A sectional view of a main part in a fitting state of devices according to the first embodiment of the present invention.

[FIG. 3]

An enlarged sectional view of a seal part in a device connection method according to a second embodiment of the present invention.

[FIG. 4]

A sectional view of an ignition coil of an example of a

device according to a prior art.

[FIG. 5]

An enlarged sectional view of a male connector for electrical connection of the device according to the prior art.

[FIG. 6]

An enlarged sectional view of a female connector for electrical connection of the device according to the prior art.

[DESCRIPTION OF THE REFERENCE NUMERALS]

- 10: ignition coil apparatus (device)
- 11: cylinder head (device receiving body)
- 12: main body portion
- 13: head portion
- 14: fitting portion
- 17: ignition coil attaching hole
- 19: fitting opening
- 21: terminal
- 22: conductor
- 23: substrate
- 24: another terminal
- 26: positioning hole (positioning means)
- 27: positioning pin (positioning means)
- 31, 32: O-ring (seal member)

[NAME OF THE DOCUMENT] ABSTRACT

[ABSTRACT]

[OBJECT] To provide a device connection method by which an electrical connection can be ensured only by connecting devices so that the connectors are omitted, thereby the electrical connection cost can be suppressed.

[SOLVING MEANS] A terminal 21 for a periphery of a fitting portion 14 of the ignition coil device 10 which is fitted to a fitting opening 19 is provided. A substrate 23 on which a conductor 22 is printed is arranged on the periphery of the fitting opening 19 of a cylinder head 11. A printed portion of the conductor 22 is extended on an inner part of the fitting opening 19 so as to form another terminal 24. The another terminal 24 is arranged to be folded in an inner periphery of the fitting opening 19. The terminal 21 and the another terminal 24 come into contact when the ignition coil device 10 is fitted into the fitting opening 19.

[SELECTED FIGURE] Fig. 1